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Signed Stephen Hordley

Dated 12 August 2003

Patents Form 1/77

Paten(t 1977
(Rule 1…)

1/77

12SEP02 E747485-6 D01821
P01/7700 0.00-0221045.8

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

THE PATENT OFFICE
J
11 SEP 2002
LONDON

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference — Jg-2892

2. Patent application number *(The Patent Office will fill in this part)* — 0221045.8 — 11 SEP 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

MICRO MEDICAL LTD
PO Box 6
Rochester,
Kent
ME1 2AZ
United Kingdom

Patents ADP number *(if you know it)* — 603381001

If the applicant is a corporate body, give the country/state of its incorporation — United Kingdom

4. Title of the invention

A ROTARY VARIABLE ORIFICE VALVE

5. Name of your agent *(if you have one)* — Graham Jones & Company

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

77 Beaconsfield Road,
Blackheath,
London
SE3 7LG

Patents ADP number *(if you know it)* — 2097001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	8
Description	
Claim(s)	
Abstract	
Drawing(s)	4

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	2
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature Date 11/09/02

12. Name and daytime telephone number of person to contact in the United Kingdom Mr. G.H. Jones 020 8858 4039

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Notes

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b) Write your answers in capital letters using black ink or you may type them.

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d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.

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Patents Form 7/77

Patents Act 1977
(Rule 15)

The Patent Office
THE PATENT OFFICE
J
11 SEP 2002
LONDON

7/77

Statement of inventorship and of right to grant of a patent

11 SEP 2002

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1.	Your reference	Jg-2892
2.	Patent application number *(if you know it)*	0221045.8
3.	Full name of the or of each applicant	MICRO MEDICAL LTD
4.	Title of the invention	A ROTARY VARIABLE ORIFICE VALVE
5.	State how the applicant*(s)* derived the right from the inventor*(s)* to be granted a patent	By virtue of agreement and conditions of employment
6.	How many, if any, additional Patents Forms 7/77 are attached to this form? *(see note (c))*	1
7.		I/We believe that the person*(s)* named over the page *(and on any extra copies of this form)* is/are the inventor*(s)* of the invention which the above patent application relates to. Signature Graham Jones Date 11/09/02
8.	Name and daytime telephone number of person to contact in the United Kingdom	Mr. G.H. Jones 020 8858 4039

Notes

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Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

Christopher Patrick <u>Lawson</u>
234 City Way,
Rochester,
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ME1 2BN
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Patents ADP number *(if you know it)*:

Patents ADP number *(if you know it)*:

Patents ADP number *(if you know it)*:

Reminder

Hav you signed the form?

A ROTARY VARIABLE ORIFICE VALVE

This invention relates to a rotary variable orifice valve. The rotary variable orifice valve may be used in apparatus for measuring the strength of a person's respiratory muscles. The rotary variable orifice valve may also be used for other applications.

According to one non-limiting embodiment of the present invention there is provided a rotary variable orifice valve comprising a cylindrical member, a sleeve which is a rotational fit with respect to the cylindrical member, and an orifice.

Usually, the sleeve will be a rotational fit over the cylindrical member.

The orifice may be of a shape that causes the resistance to flow of the rotary variable orifice valve to increase with rotation.

Preferably, the orifice is of a triangular shape. The orifice may be of other shapes if desired.

The rotary variable orifice valve may be one in which the cylindrical member has an aperture, the sleeve has the orifice, and the aperture and the orifice are positioned such that they overlap as the sleeve rotates. Alternatively, the rotary variable orifice valve may be one in which the cylindrical member has the orifice, the sleeve has the aperture, and the aperture and the orifice are positioned such that they overlap as the sleeve rotates. Alternatively, the rotary variable orifice valve may be one in which

the orifice is positioned partly in the cylindrical member, and partly in the sleeve.

The present invention also extends to the combination of the rotary variable orifice valve, and a motor for operating the rotary variable orifice valve.

The rotary variable orifice valve may advantageously by employed in apparatus for measuring the strength of a person's respiratory muscles, which apparatus comprises a mouthpiece for the person, a flow transducer, a pressure transducer, a variable orifice valve, a motor for operating the variable orifice valve, and microprocessor control means, the microprocessor control means being such that it is able to control the motor to cause the variable orifice valve to vary its orifice size and thereby to maintain a constant predetermined pressure and enable the measurement of the flow rate generated by the person, or to maintain a constant predetermined flow rate and enable the measurement of the pressure generated by the person.

Usually, the flow rate or the pressure generated by the person will be generated by inhalation, but exhalation may be employed if desired.

Preferably, the apparatus of the invention will be used such that the microprocessor control means maintains different constant predetermined pressures, and measures the flow rate generated by the person at these constant predetermined pressures. If desired however, the apparatus of the present invention may be used such that the microprocessor control means maintains different predetermined flow rates and measures the pressure

generated by the person. Either way, a maximum inspiratory pressure curve can be built up, and weak parts of the person's respiratory muscles can be seen from the curve. Corrective respiratory exercises can then be prescribed to strengthen any weak range or ranges of the respiratory muscles. For persons with weak respiratory muscles, the variable orifice will generally be small for the maximum inspired flow rate at a chosen pressure. For persons with strong respiratory muscles, the variable orifice will generally be large for the maximum inspired flow rate at a chosen pressure. Various exercises can be prescribed for persons with weak respiratory muscles over various ranges in order to improve the strength of the respiratory muscles over these ranges.

The apparatus may include a control circuit, the flow transducer being connected to the control circuit, the pressure transducer being connected to the variable orifice valve and to the control circuit, the pressure transducer being connected to the rotary variable orifice valve and to the control circuit, and the control circuit being connected to the microprocessor control means.

The microprocessor control means may comprise a microprocessor circuit, display means and a keypad.

The display means may be a display screen and/or a hard copy print device.

Preferably, the mouthpiece has a flange at the end of the mouthpiece that goes into the person's mouth. The flange helps the person's mouth to seal around the mouthpiece during the inhalation.

With the use of the rotary variable orifice valve, friction may be independent of applied pressure. The relationship between the resistance to flow and rotation of the valve is able easily to be adjusted by the shape of the orifice.

An embodiment of the invention will now be described solely by way of example and with reference to the accompanying drawings in which:

Figure 1 shows apparatus for measuring the strength of a person's respiratory muscles;

Figure 2 is a block circuit diagram of the apparatus shown in Figure 1;

Figure 3 shows a curve obtained by measuring pressure against flow and obtaining maximum inspired flows at different pressures; and

Figure 4 is a perspective view of a rotary variable orifice valve which is used in the apparatus shown in Figure 1.

Referring to Figures 1 – 4, there is shown apparatus 2 for measuring the strength of a person's respiratory muscles. The apparatus 2 comprises a mouthpiece 4 for being inhaled through on by the person, a variable orifice valve arrangement 6, and microprocessor control means 8. The variable orifice valve arrangement 6 comprises a variable orifice valve 10 and a motor 12 for operating the variable orifice valve 10. The microprocessor control means 8 is such that it is able to control the motor 12 to cause the variable orifice valve 10 to vary its orifice size and thereby to maintain a constant predetermined pressure and enable the measurement of the flow rate generated by the person, or to maintain a constant predetermined flow rate and enable the measurement of the pressure generated by the person.

The variable orifice valve arrangement 6 also comprises a control circuit 20 and a pressure transducer 22. A flow transducer 18 is positioned between the mouthpiece 4 and the variable orifice valve arrangement 6.

The constant respiratory pressure transducer 6 is connected to the microprocessor control means 8 by a lead 14 as shown in Figure 1.

During use of the apparatus 2, for a person with weak lungs, the orifice in the variable orifice valve 10 will usually be relatively small for the maximum inspired flow rate. For a person with strong lungs, the orifice in the variable orifice valve 10 will usually be relatively large for the maximum inspired flow rate. Measurements can be taken of pressure against flow in order to build up a maximum inspiratory pressure curve 16 as shown in Figure 3. If the measurements being taken fluctuate due to uneven inhalation by the person, then a suitable algorithm may be employed to provide an average for each measurement. The curve 16 is then useful for identifying areas of weakness in the person's respiratory muscles. The person, for example a patient shortly to undergo major heart surgery, or an athlete, can then be given remedial exercises to strengthen their respiratory muscles over the weak range or ranges. In the case of persons about to undergo major surgery, the improved respiratory muscles will increase their chances of survival. In the case of athletes, improved respiratory muscles may result in improved performances.

As shown in Figure 2, the flow transducer 18 is connected to the control circuit 20. The pressure transducer 22 is connected to the variable orifice valve 10 and to the control circuit 20. The control circuit 20 is

connected to a microprocessor circuit 24 of the microprocessor control means 8. The microprocessor circuit 24 is also connected to display means 26 and a keypad 28.

As shown in Figure 1, the display means 26 comprises a display screen 30 and a hard copy print device 32. The display screen 30 is shown displaying a maximum inspiratory pressure curve 16. The print device 32 is shown having provided a hard copy print 34.

The mouthpiece 4 has a flange 36 at the end of the mouthpiece that goes into the person's mouth. The flange 36 helps the person's mouth to seal around the mouthpiece 4 during inhalation. The other end 38 of the mouthpiece 4 is cylindrical for being a push fit over a cylindrical part 40 of the constant respiratory pressure transducer 6.

Figure 4 shows in detail the rotary variable orifice valve 10. The rotary variable orifice valve 10 does not generate friction so that friction is independent of applied pressure. The relationship between resistance to flow and rotation of the valve is easily adjusted by adjusting the shape of an orifice 44. The orifice 44 is of a shape that causes the resistance to flow of the rotary variable orifice valve 10 to increase with rotation. More specifically, the orifice 44 is of a triangular shape as shown.

The rotary variable orifice valve 10 comprises a cylindrical member 46 having a bore 48 and a rectangular aperture 50. The orifice 44 is in a sleeve 52 which is a rotational fit over the cylindrical member 46. As shown in Figure 4, the cylindrical member 46 is in the form of a short tube. During use of the rotary variable orifice valve 42, the sleeve 52 rotates over the

cylindrical member 46, and the orifice 44 overlaps by varying amounts the rectangular aperture 50. In this way, the effective size of the orifice 44 is varied.

The rotation of the sleeve 52 is controlled by the motor 12. The motor 12 is mounted on one side of the sleeve 52. The motor 12 has a pulley 54 which drives an endless drive belt 56. The drive belt 56 is in frictional engagement with the outside of the sleeve 52 as shown. Thus rotation of the pulley 54 clockwise or anticlockwise, causes a corresponding rotation of the sleeve 52 via the drive belt 56.

The motor 12 is mounted on a motor mounting plate 58.

It is to be appreciated that the embodiment of the invention described above with reference to the accompanying drawings has been given by way of example only and that modifications may be effected. Thus, for example, with reference to Figure 4, the motor 12 may be arranged to drive the sleeve 56 by means other than the drive belt 56. Thus, for example, the drive could be via toothed wheels. Also, if desired, the motor 12 could be mounted in line with the cylindrical member 46 and then connected to the sleeve 52 by an appropriate drive arrangement. The motor 10 may be battery operated and/or mains operated. In Figure 3, the curve 16 has been obtained by causing the microprocessor control means 8 to control the motor 12 to cause the variable orifice valve 10 to vary its orifice size and thereby to maintain constant predetermined pressures, so that the flow rate generated by the person can be measured. If desired however, the curve 16 may be obtained by causing the microprocessor control means 16 to control the

motor 12 to cause the variable orifice valve 10 to vary its orifice size and thereby to maintain constant predetermined flow rates, so that the pressure generated by the person can be measured.

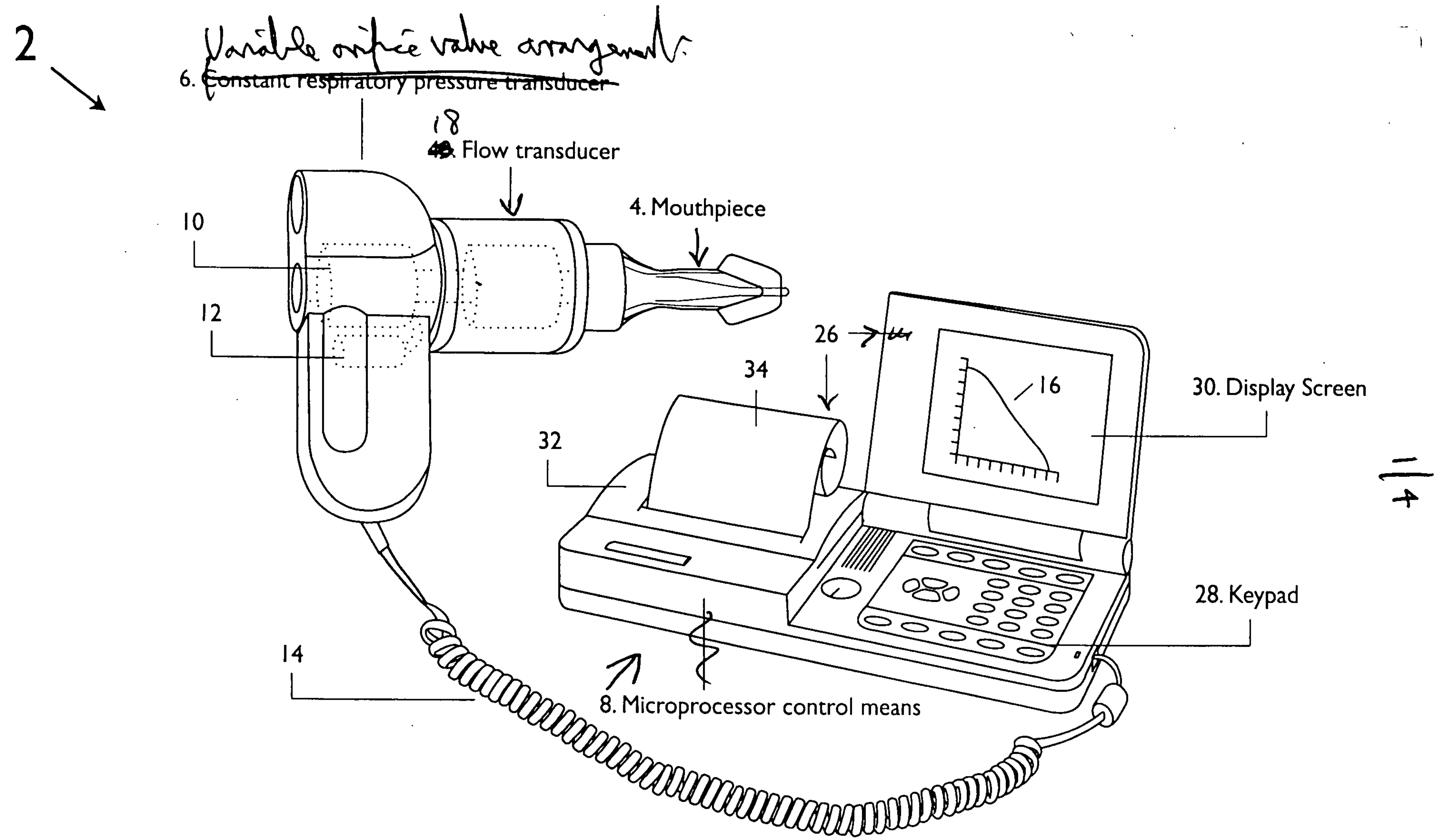
2
Variable orifice valve arrangement
6. ~~Constant respiratory pressure transducer~~
18
~~40~~. Flow transducer
4. Mouthpiece
10
12
26
34
16
30. Display Screen
32
28. Keypad
14
8. Microprocessor control means

FIG 1

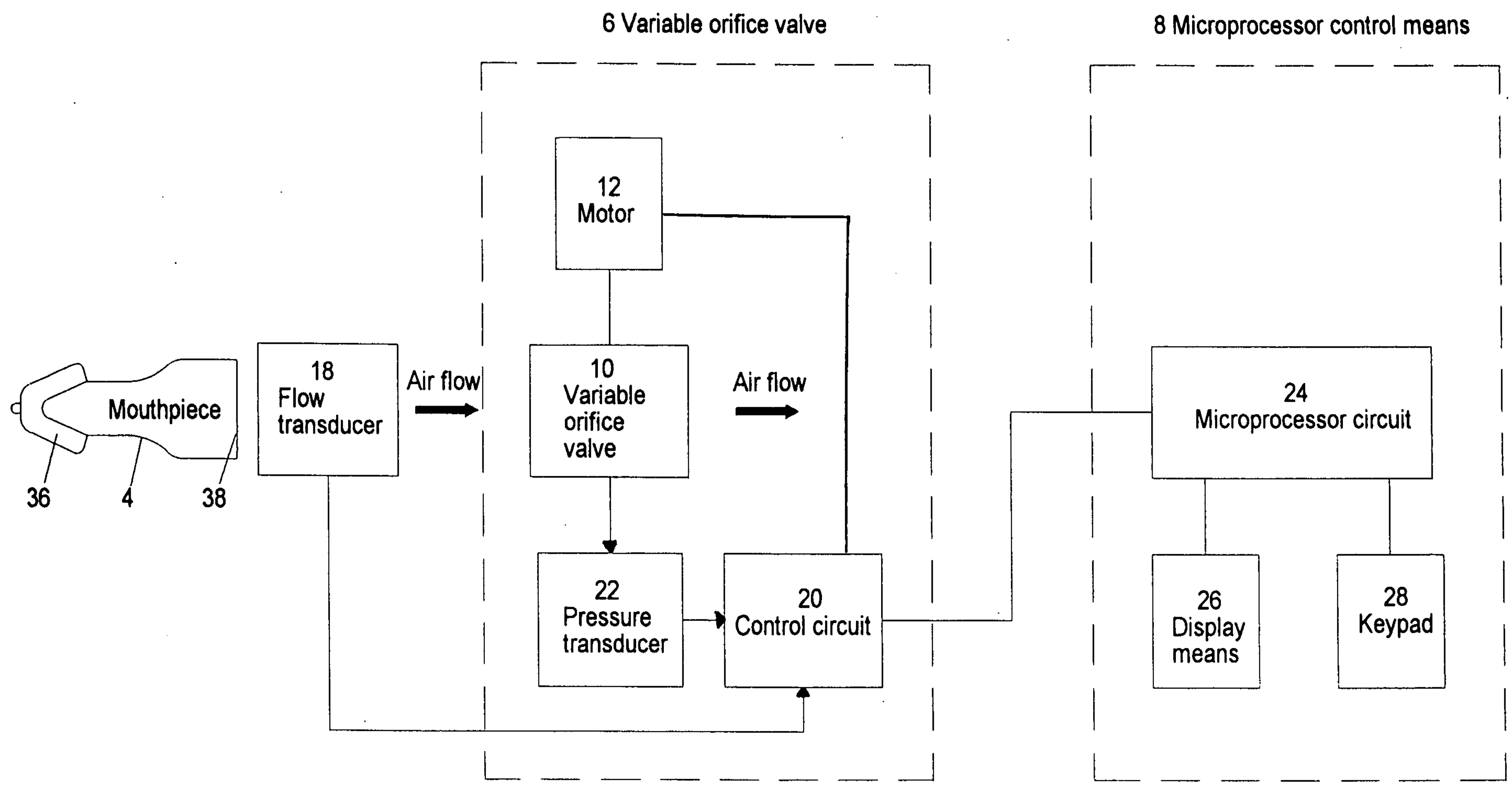
6 Variable orifice valve
8 Microprocessor control means
12 Motor
18 Flow transducer
Air flow
10 Variable orifice valve
Air flow
24 Microprocessor circuit
Mouthpiece
36
4
38
22 Pressure transducer
20 Control circuit
26 Display means
28 Keypad

FIG 2

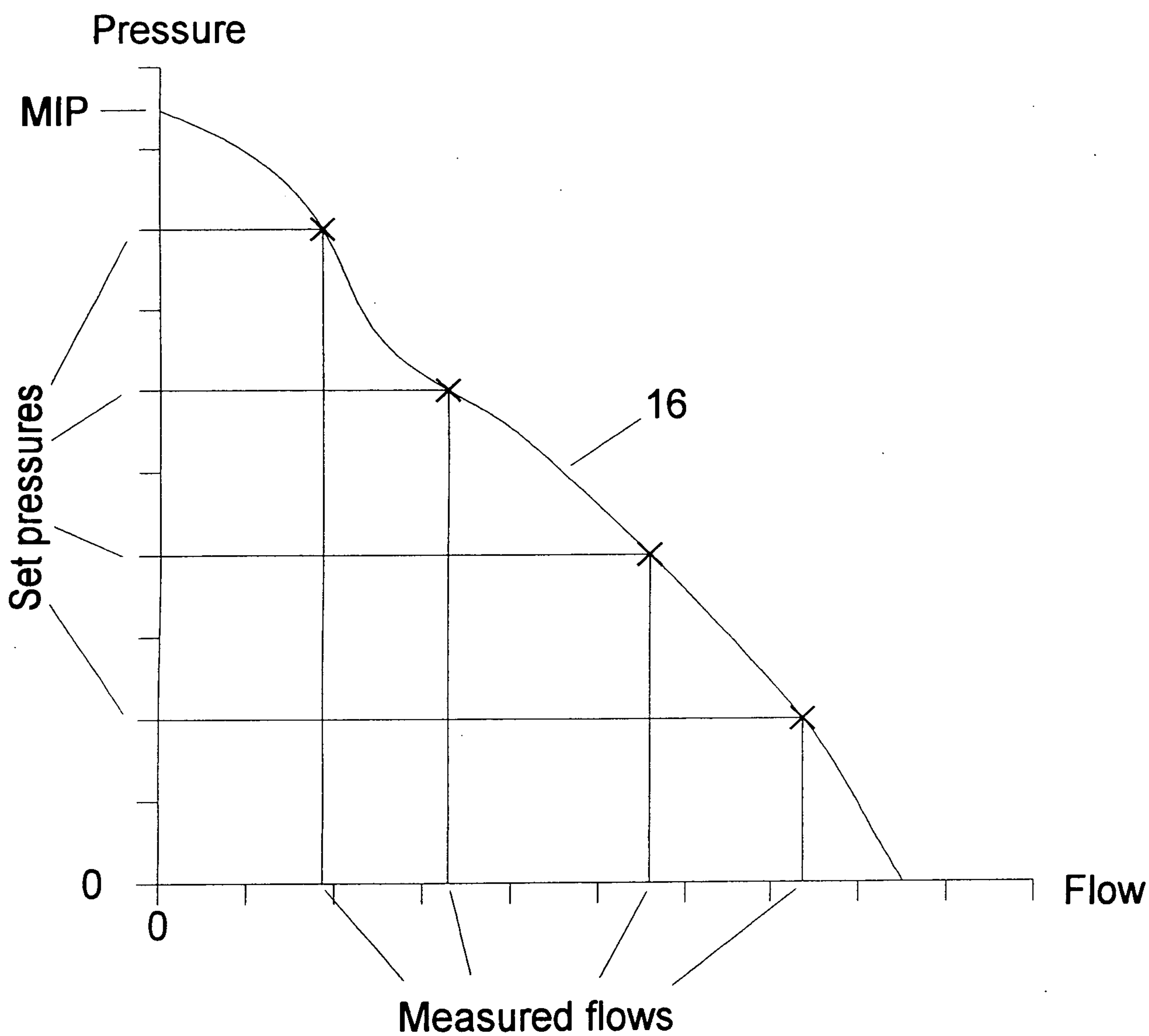

FIG 3

Rotary variable orifice valve

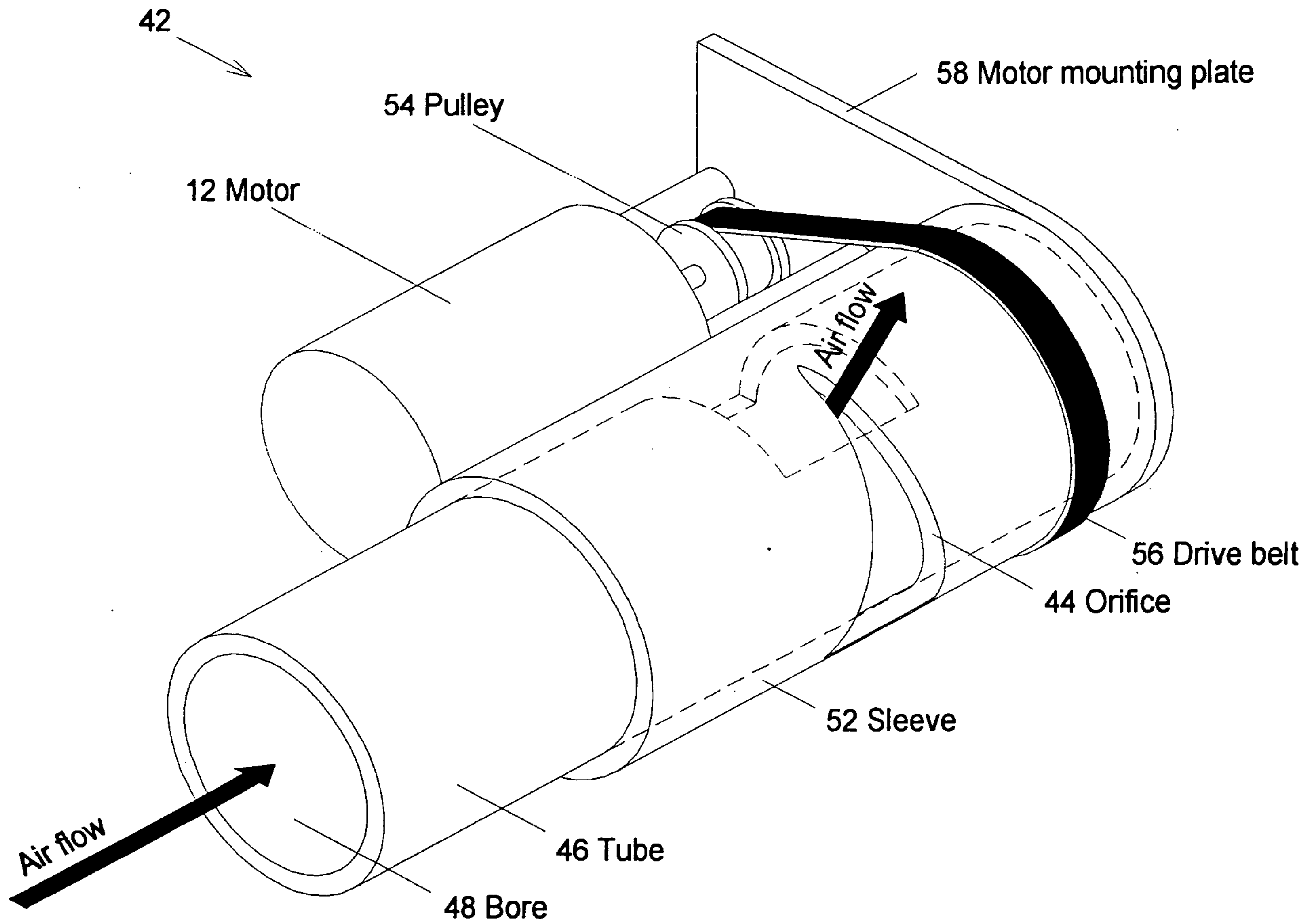

FIG 4